

Remarks

The Office Action mailed September 18, 2007, and made final, has been carefully reviewed and the foregoing amendment and following remarks have been made in consequence thereof.

Claims 1-32 are now pending in this application. Claims 1-3, 6-9, 13-15, 17-20, 24-26, and 28-30 stand rejected. Claims 4, 5, 10-12, 16, 21-23, 27, 31, and 32 stand objected to.

The rejection of Claims 1-3, 6-9, 15, 25, 26, and 28-30 under 35 U.S.C. § 103(a) as being unpatentable over Harvey (U.S. Pat. No. 6,275,038) ("Harvey") in view of Gur et al. (U.S. Pat. No. 5,627,907) ("Gur") is respectfully traversed.

Harvey describes a method for evaluating an inhomogeneity in a magnetic polarizing field. The method includes acquiring data using a first k-space scan ($S1(k_x, k_y)$) and a second k-space scan ($S2(k_x, k_y)$) during a single application of a magnetic resonance imaging (MRI) pulse sequence (70). The second k-space scan ($S2(k_x, k_y)$) is time delayed from the first k-space scan ($S1(k_x, k_y)$). A first spatial image ($IM1(x, y)$) and a second spatial image ($IM2(x, y)$) are generated from the first k-space scan ($S1(k_x, k_y)$) and the second k-space scan ($S2(k_x, k_y)$), respectively. A first measurement of inhomogeneity is generated from the first spatial image ($IM1(x, y)$), and a second measurement of inhomogeneity is generated from the second spatial image ($IM2(x, y)$). As such, the first and second measurements of inhomogeneity are generated using a pair of images ($IM1(x, y)$ and $IM2(x, y)$). A measurement of the change is determined by the difference between the first and second measurements of inhomogeneity with respect to phase difference and the time delay. The measurement of the change is used to correct for instrumental error phase accumulation.

Applicant respectfully traverses the assertion on page 4 of the Office Action that Harvey describes generating a first estimate and a second estimate of inhomogeneity using the acquired image. Rather, in contrast to such an assertion, Harvey describes generating first and second measurements of inhomogeneity *using a pair of images*. For example, at column 4 lines 50-63, Harvey describes "a method for providing a substantially real time measurement of a change in a magnetic field at a point in a slice of a subject positioned in a polarizing magnetic field, the method comprising: measuring an inhomogeneity in the polarizing magnetic field at the point at a first time to acquire a first measurement of the

inhomogeneity using a method in accordance with a preferred embodiment of the present invention; *repeating the measurement at a second time following a short delay to acquire a second measurement of the inhomogeneity*; and providing a measurement of the change by determining a difference between the first and second measurements. Preferably, the first and second measurements are performed with a shallow flip angle.” (Emphasis added.) Applicant respectfully submits that if a second inhomogeneity is measured at a second time, the second inhomogeneity is not generated using the same acquired image that was used to generate a first measurement of inhomogeneity. In fact, in the above recited method, and in further contrast to the assertion that Harvey describes generating a first estimate and a second estimate of inhomogeneity using the acquired image at column 4 lines 46-63, Harvey does not describe or suggest using images to generate the first and second measurements of inhomogeneity.

With respect to using images to generate the inhomogeneity at a point, Harvey describes at column 3 lines 17-29, “a method for evaluating an inhomogeneity in a magnetic polarizing field used to acquire an MRI image of a slice of a subject, at a point in the slice, the method comprising: acquiring data in a k-space for first and second k-space scans of the subject with a single application of a first MRI pulse sequence, wherein data acquisition for the second k-space scan is delayed with respect to data acquisition for the first k-space scan by a time delay; generating first and second spatial images from the first and second k-space scans; determining a phase difference between values of the first and second spatial images at the point; and evaluating the inhomogeneity at the point using the phase difference and the time delay.” As such, Harvey describes using a pair of images to determine a phase difference and using the determined phase difference to evaluate an inhomogeneity. Harvey does not describe or suggest generating first and second estimates of inhomogeneity using an acquired image. Rather, in contrast, Harvey describes using a first and second image to generate a single evaluation of inhomogeneity.

Gur describes a method for detecting abnormal regions in living tissue depicted in a radiograph. A pair of digital mammograms are obtained (S1) by a device (1) and/or a digitizer (9). Each image of the pair is segmented or normalized (S2). After each image is boundary enhanced (S3), the images are aligned and subtracted (S4). Non-linear thresholding is performed (S5) on the subtracted images, based on digital values in the pair of original images. The pair of thresholded images is used to label and size blobs (S6) to identify

suspected abnormal regions. Gur further describes that the enhanced images may be subtracted then thresholded to generate a binary image showing blobs. Notably, Gur does not describe or suggest that the threshold is generated using an acquired image. Rather, Gur describes that an image is generated using a threshold.

Applicant respectfully notes that the Office has not cited to any place in Gur that describes or suggests that a threshold value *is generated using an acquired image*. Because no citations are made to Gur that show where the recitations that are not described by Harvey are described therein, in the event the Office maintains its rejection of the claims in view of Gur, Applicant respectfully requests that the Office clearly delineate and point out the features disclosed by Gur that the Office believes corresponds to the features recited in the claims.

As asserted on page 3 of the Office Action, claim language is given its broadest reasonable interpretation. However, the words used in a claim must be given effect. More specifically, Claims 1, 13, and 25 recite "an acquired image" and subsequently throughout each claim, "the acquired image." Because the presently pending claims refer to only one image throughout the recitations, only one image is used to find both the first inhomogeneity and the second inhomogeneity. Further, the presently pending specification refers to only one acquired image Ia. As such, the recitations of the presently pending claims should not be read to include a method including using a pair of images to evaluate a single inhomogeneity, as described in Harvey.

Claim 1 recites a method for generating an estimate of inhomogeneity, said method comprising "acquiring an image; generating a threshold value using the acquired image; generating a first estimate of inhomogeneity using the acquired image; generating a second estimate of inhomogeneity using the same acquired image used to generate the first estimate of inhomogeneity; and generating a final estimate of inhomogeneity for the acquired image using at least the first and second estimates and the threshold value."

Neither Harvey nor Gur, considered alone or in combination, describes or suggests a method for generating an estimate of inhomogeneity as recited in Claim 1. More specifically, neither Harvey nor Gur, considered alone or in combination, describes or suggests a method that includes generating a first and a second estimate of inhomogeneity using the same acquired image. Further, neither Harvey nor Gur, considered alone or in combination,

describes or suggests a method that includes generating a threshold value using an acquired image. Moreover, neither Harvey nor Gur, considered alone or in combination, describes or suggests a method that includes generating a final estimate of inhomogeneity for the acquired image using at least the first and second estimates of inhomogeneity and the threshold value. Rather, Harvey describes generating a first measurement of inhomogeneity at a first time and generating a second measurement of inhomogeneity at a second time that is delayed from the first time. Harvey further describes that a pair of time-delayed images and the phase difference between the images are used to evaluate an inhomogeneity. Gur describes applying a threshold to generate an image.

Accordingly, for at least the reasons set forth above, Claim 1 is submitted as patentable over Harvey in view of Gur.

Claims 2, 3, and 6-9 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2, 3, and 6-9 are considered in combination with the recitations of Claim 1, Applicant submits that dependent Claims 2, 3, and 6-9 likewise are patentable over Harvey in view of Gur.

Furthermore, with respect to Claim 2, the Office does not cite to anywhere in Harvey and/or Gur that describes or suggests "generating a second estimate of inhomogeneity using an operation other than filtering on an image g_m ." Accordingly, Applicant respectfully submits that Claim 2 is patentable over Harvey in view of Gur. However, in the event the Office maintains its rejection of Claim 2 in view of Harvey and Gur, Applicant respectfully requests that the Office clearly delineate and point out the features disclosed by Harvey and/or Gur that the Office believes corresponds to at least each and every feature recited in Claim 2.

Claim 15 depends from independent Claim 13, which recites a magnetic resonance imaging (MRI) system comprising "a main magnet configured to generate a substantially uniform magnetic field; a radio frequency pulse generator configured to excite the magnetic field; a gradient field generator configured to generate gradients extending in different directions in the magnetic field; a receiver configured to receive magnetic field magnetic resonance (MR) signals representative of an object; and a computer operationally coupled to said receiver, said computer configured to: acquire an image; generate a threshold value using the acquired image; generate a first estimate of inhomogeneity using the acquired image;

generate a second estimate of inhomogeneity using the same acquired image used to generate the first estimate of inhomogeneity; and generate a final estimate of inhomogeneity for the acquired image using at least the first and second estimates and the threshold value.”

As acknowledged on page 10 of the Office Action, Harvey does not describe or suggest a main magnet configured to generate a substantially uniform magnetic field; a radio frequency pulse generator configured to excite the magnetic field; a gradient field generator configured to generate gradients extending in different directions in the magnetic field; a receiver configured to receive magnetic field magnetic resonance (MR) signals representative of an object; and a computer operationally coupled to said receiver, said computer configured to generate a threshold value using the acquired image.

Further, Applicant respectfully notes that the Office has not cited to any place in Harvey and/or Gur that describes or suggests each and every element of Claim 13, from which Claim 15 depends. In fact, Claim 15 has not been addressed in the Section 103 rejection over Harvey in view of Gur. Accordingly, for this reason alone, Applicant respectfully submits that Claim 15 is patentable over Harvey in view of Gur. However, in the event the Office maintains its rejection of Claim 15 in view of Harvey and Gur, Applicant respectfully requests that the Office clearly delineate and point out the features disclosed by Harvey and/or Gur that the Office believes corresponds to at least each and every feature recited in Claim 13.

Moreover, neither Harvey nor Gur, considered alone or in combination, describes or suggests a magnetic resonance imaging (MRI) system as recited in Claim 13. More specifically, neither Harvey nor Gur, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a first and second estimate of inhomogeneity using the same acquired image. Further, neither Harvey nor Gur, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a threshold value using the acquired image. Moreover, neither Harvey nor Gur, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a final estimate of inhomogeneity for an acquired image using at least the first and second estimates of inhomogeneity and the threshold value. Rather, Harvey describes generating a first measurement of inhomogeneity at a first time and generating a second measurement of inhomogeneity at a second time that is delayed from the

first time. Harvey further describes that a pair of time-delayed images and the phase difference between the images are used to evaluate an inhomogeneity. Gur describes applying a threshold to generate an image.

Accordingly, for at least the reasons set forth above, Claim 13 is submitted as patentable over Harvey in view of Gur.

When the recitations of Claim 15 are considered in combination with the recitations of Claim 13, Applicant submits that dependent Claim 15 likewise is patentable over Harvey in view of Gur.

Claim 25 recites a computer readable medium encoded with a program configured to instruct a computer to "acquire an image; generate a threshold value using the acquired image; generate a first estimate of inhomogeneity using the acquired image; generate a second estimate of inhomogeneity using the same acquired image used to generate the first estimate of inhomogeneity; and generate a final estimate of inhomogeneity for the acquired image using at least the first and second estimates and the threshold value."

Neither Harvey nor Gur, considered alone or in combination, describes or suggests a computer readable medium encoded with a program configured to instruct a computer as recited in Claim 25. Specifically, neither Harvey nor Gur, considered alone or in combination, describes or suggests a computer readable medium encoded with a program configured to instruct a computer to generate a first and a second estimate of inhomogeneity using the same acquired image. Further, neither Harvey nor Gur, considered alone or in combination, describes or suggests a computer readable medium encoded with a program configured to instruct a computer to generate a threshold value using the acquired image. Moreover, neither Harvey nor Gur, considered alone or in combination, describes or suggests a computer readable medium encoded with a program configured to instruct a computer to generate a final estimate of inhomogeneity for the acquired image using at least the first and second estimates of inhomogeneity and the threshold value. Rather, Harvey describes generating a first measurement of inhomogeneity at a first time and generating a second measurement of inhomogeneity at a second time that is delayed from the first time. Harvey further describes that a pair of time-delayed images and the phase difference between the images are used to evaluate an inhomogeneity. Gur describes applying a threshold to generate an image.

Accordingly, for at least the reasons set forth above, Claim 25 is submitted as patentable over Harvey in view of Gur.

Claims 26 and 28-30 depend, directly or indirectly, from independent Claim 25. When the recitations of Claims 26 and 28-30 are considered in combination with the recitations of Claim 25, Applicant submits that dependent Claims 26 and 28-30 likewise are patentable over Harvey in view of Gur.

In addition, if art "teaches away" from a claimed invention, such a teaching supports the nonobviousness of the invention. U.S. v. Adams, 148 USPQ 479 (1966); Gillette Co. v. S.C. Johnson & Son, Inc., 16 USPQ2d 1923, 1927 (Fed. Cir. 1990). In light of this standard, it is respectfully submitted that the cited art, as a whole, is not suggestive of the presently claimed invention. More specifically, Harvey is directed to evaluating an inhomogeneity in a magnetic polarizing field. Harvey describes, in one embodiment, an inhomogeneity is evaluated using a phase difference that was generated from a pair of images. Column 3, lines 17-29. Harvey describes, in another embodiment, acquiring a first measurement of the inhomogeneity at a first time, acquiring a second measurement of the inhomogeneity at a second time following a short delay, and determining a difference between the first and second measurements. Column 4, lines 50-63. Such descriptions teach away from generating a first and a second estimate of inhomogeneity using an acquired image. As such, one of ordinary skill in the art would not look to Harvey, which describes that two images and/or two times are used to determine inhomogeneity, to arrive at the presently pending claims, which are directed to generating a final estimate of inhomogeneity using at least first and second estimates of inhomogeneity and the threshold value, wherein the first and second estimates of inhomogeneity and the threshold value were generating using an acquired image.

Further, Gur is directed to a method for detecting abnormal regions in living tissue depicted in a radiograph. More specifically, Gur describes a method that "produces two low-pass filtered images from which a binary image is created (in step S320) by subtraction and thresholding." Column 14, lines 46-48. Gur also describes that "Gaussian bandpass filtering and non-linear global thresholding are used during segmentation." Column 17, lines 34-36. As such, one of ordinary skill in the art would not look to Gur, which describes that thresholding generates an image, to arrive at the presently pending claims, which are directed to generating a threshold value using an acquired image. Accordingly, Applicant respectfully

requests that the Section 103 rejection of Claims 1-3, 6-9, 15, 25, 26, and 28-30 over Harvey in view of Gur be withdrawn.

For at least the reasons set forth above, Applicant respectfully requests that the Section 103 rejection of Claims 1-3, 6-9, 15, 25, 26, and 28-30 be withdrawn.

The rejection of Claim 13 under 35 U.S.C. § 103(a) as being unpatentable over Harvey in view of Dean et al. (U.S. Pat. No. 6,445,182) ("Dean") is respectfully traversed.

Harvey is described above. Dean describes a three-dimensional (3D) magnetic resonance imaging (MRI) system (100) that performs object-induced geometric distortion correction. The MRI system (110) includes a static magnet (132) for producing a substantially uniform magnetic field, a pulse program generator (142) for controlling a set of gradient amplifiers and coils (134), and a radio frequency transmitter (152) for causing magnetic resonance in the aligned dipoles of a subject (102). A MRI pulse sequence is performed to acquire (202) a first 3D magnetic resonance (MR) image. The MRI pulse sequence is repeated to acquire (202) a second 3D MR image. A computer system (110) computes (210) a voxel error map based on a phase difference (204) between the first and the second 3D MR images. The computer system (110) then corrects (212) voxel positions in one of the 3D MR images in accordance with the voxel error map.

Initially, Applicant respectfully notes that the recitations "a computer configured to generate a threshold value using the acquired image" and "a computer configured to generate a final estimate of inhomogeneity for an acquired image using at least the first and second estimates of inhomogeneity and the threshold value" in Claim 13 are not addressed in the Section 103 rejection over Harvey in view of Dean. Accordingly, for this reason alone, Applicant respectfully submits that Claim 13 is patentable over Harvey in view of Dean. However, in the event the Office maintains its rejection of Claim 13 in view of Harvey and Dean, Applicant respectfully requests that the Office clearly delineate and point out the features disclosed by Harvey and/or Dean that the Office believes corresponds to at least each and every feature recited in Claim 13.

Claim 13 recites a magnetic resonance imaging (MRI) system comprising "a main magnet configured to generate a substantially uniform magnetic field; a radio frequency pulse generator configured to excite the magnetic field; a gradient field generator configured to generate gradients extending in different directions in the magnetic field; a receiver

configured to receive magnetic field magnetic resonance (MR) signals representative of an object; and a computer operationally coupled to said receiver, said computer configured to: acquire an image; generate a threshold value using the acquired image; generate a first estimate of inhomogeneity using the acquired image; generate a second estimate of inhomogeneity using the same acquired image used to generate the first estimate of inhomogeneity; and generate a final estimate of inhomogeneity for the acquired image using at least the first and second estimates and the threshold value."

Neither Harvey nor Dean, considered alone or in combination, describes or suggests a magnetic resonance imaging system as recited in Claim 13. More specifically, neither Harvey nor Dean, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a first and a second estimate of inhomogeneity using the same acquired image. Further, neither Harvey nor Dean, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a threshold value using the acquired image. Moreover, neither Harvey nor Dean, considered alone or in combination, describes or suggests a magnetic resonance imaging system that includes a computer configured to generate a final estimate of inhomogeneity for an acquired image using at least the first and second estimates of inhomogeneity and the threshold value. Rather, Harvey describes generating a first measurement of inhomogeneity at a first time and generating a second measurement of inhomogeneity at a second time that is delayed from the first time. Harvey further describes that a pair of time-delayed images and the phase difference between the images are used to evaluate an inhomogeneity. Dean merely describes a system that includes a static magnet for producing a substantially uniform magnetic field, a pulse program generator for controlling a set of gradient amplifiers and coils, and a radio frequency transmitter for causing magnetic resonance in the aligned dipoles of a subject.

Accordingly, for at least the reasons set forth above, Claim 13 is submitted as patentable over Harvey in view of Dean.

For at least the reasons set forth above, Applicant respectfully requests that the Section 103 rejection of Claim 13 be withdrawn.

The rejection of Claims 14, 15, 17-20, and 24 under 35 U.S.C. § 103(a) as being unpatentable over Harvey and Dean, and further in view of Gur is respectfully traversed.

Harvey, Dean, and Gur are described above.

Claims 14, 15, 17-20, and 24 depend, directly or indirectly, from Claim 13, which recites a magnetic resonance imaging (MRI) system comprising "a main magnet configured to generate a substantially uniform magnetic field; a radio frequency pulse generator configured to excite the magnetic field; a gradient field generator configured to generate gradients extending in different directions in the magnetic field; a receiver configured to receive magnetic field magnetic resonance (MR) signals representative of an object; and a computer operationally coupled to said receiver, said computer configured to: acquire an image; generate a threshold value using the acquired image; generate a first estimate of inhomogeneity using the acquired image; generate a second estimate of inhomogeneity using the same acquired image used to generate the first estimate of inhomogeneity; and generate a final estimate of inhomogeneity for the acquired image using at least the first and second estimates and the threshold value."

None of Harvey, Dean, and Gur, considered alone or in combination, describe or suggest a magnetic resonance imaging system as recited in Claim 13. More specifically, none of Harvey, Dean, and Gur, considered alone or in combination, describe or suggest a magnetic resonance imaging system that includes a computer configured to generate a first and a second estimate of inhomogeneity using the same acquired image. Further, none of Harvey, Dean, and Gur, considered alone or in combination, describe or suggest a magnetic resonance imaging system that includes a computer configured to generate a final estimate of inhomogeneity for an acquired image using at least the first and second estimates of inhomogeneity and the threshold value. Rather, Harvey describes generating a first measurement of inhomogeneity at a first time and generating a second measurement of inhomogeneity at a second time that is delayed from the first time. Harvey further describes that a pair of time-delayed images and the phase difference between the images are used to evaluate an inhomogeneity. Dean merely describes a system that includes a static magnet for producing a substantially uniform magnetic field, a pulse program generator for controlling a set of gradient amplifiers and coils, and a radio frequency transmitter for causing magnetic resonance in the aligned dipoles of a subject, and Gur describes applying a threshold to generate an image.

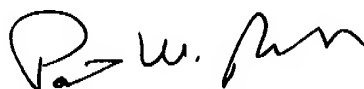
Accordingly, for at least the reasons set forth above, Claim 13 is submitted as patentable over Harvey and Dean in view of Gur.

When the recitations of Claims 14, 15, 17-20, and 24 are considered in combination with the recitations of Claim 13, Applicant submits that dependent Claims 14, 15, 17-20, and 24 likewise are patentable over Harvey and Dean in view of Gur.

For at least the reasons set forth above, Applicant respectfully requests the Section 103 rejection of Claims 14, 15, 17-20, and 24 be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully submitted,



Patrick W. Rasche
Registration No. 37,916
ARMSTRONG TEASDALE LLP
One Metropolitan Square, Suite 2600
St. Louis, Missouri 63102-2740
(314) 621-5070